CURRICULUM / COURSE SYNOPSIS FOR MSC PROGRAMME

GENERAL COURSES

First Semester

Course Codes	***Course Title***	***Units***
Generic Core Courses		
CSC711	Research Methodology and Application of ICT in Research	3
Programme Core Courses		
CSC801	Operating Systems	3
CSC803	Advanced Computer Architecture	3
CSC805	Software Engineering	3
CSC807	Artificial Intelligence	3
	Sub-Total	**15**

Second Semester

Course Codes	***Course Title***	***Units***
Programme Core Courses		
CSC802	Computer Communications and Networks	3
CSC804	Programming Languages	3
CSC806	Advanced Computer Algorithms	3
	Sub-Total	**9**

Third Semester

Course Codes	***Course Title***	***Unit***
Programme Core Courses		
CSC809	Seminar	**3**
CSC849	Thesis	6
	Sub- Total	**9**
	Total	**33**

COURSES BY SPECIALIZATION

1. SYSTEMS ENGINEERING

First Semester

Course Codes	*Course Title*	*Units*
Core Courses		
CSC819	Control Systems and Robotics	3
Electives	**Choose any One**	
CSC815	Digital Signal Processing	3
CSC817	Parallel and Distributed Computing	3
CSC803	Advanced Computer Architecture	3
	Sub-Total	**6**

Second Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC812	Embedded Systems	3
Electives	**Choose One**	
CSC810	Real Time Operating Systems	3
CSC808	Switching and Fault Diagnosing	3
	Sub-Total	**6**

2. SOFTWARE ENGINEERING

First Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC821	Software Quality Assurance	3
Electives	**Choose any One**	
CSC823	Advanced Computer Graphics	3
CSC825	Advanced Topics in Computer Network	3
CSC827	Object Oriented Programming	3
CSC829	Internet Technology	3
CSC831	Object Oriented Software Engineering	3
	Sub-Total	**6**

Second Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC814	Software Project Management	3
Electives	**Choose any One**	
CSC816	Database Systems	3
CSC818	Advanced Software Engineering	3
CSC820	Electronic Commerce Technologies	3
CSC822	Design of Complex Software Systems	3
CSC826	SAP and/or Other ERPSS	3
	Sub-Total	**6**

3. ARTIFICIAL INTELLIGENCE

First Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC839	Control Systems and Robotics	3
Electives	**Choose any One**	
CSC835	Theory of Computation	3
CSC812	Embedded Systems	3
CSC829	Internet Technology	3
CSC843	Agent Technology	3
	Sub-Total	**6**

Second Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC840	Decision Support Systems	3
Electives	**Choose any One**	
CSC830	Human Computer Interaction	3
CSC832	Expert Systems	3
CSC834	Bioinformatics	3
CSC836	Machine Learning	3
CSC838	Neural Networks	3
	Sub-Total	**6**

4. COMPUTER NETWORKS

First Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC845	Network Design	3
Electives	**Choose any One**	
CSC815	Digital Signal Processing	3
CSC847	Mobile and Adaptive Systems	3
CSC829	Internet Technology	3
	Sub-Total	**6**

Second Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC842	Network Administration and Management	3
Electives	**Choose any One**	

CSC844	Advanced Topics in Computer Network	3
CSC846	Network Programming	3
CSC848	Network Performance Evaluation	3
CSC850	Wireless and Ad-hoc Networks	3
CSC852	Network Security	3
	Sub-Total	**6**

5. THEORETICAL COMPUTER SCIENCE

First Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC835	Theory of Computation	3
Electives	**Choose any One**	
CSC816	Database Systems	3
CSC820	Electronic Commerce Technologies	3
CSC829	Internet Technology	3
	Sub-Total	**6**

Second Semester

Course Codes	*Course Title*	*Unit*
Core Courses		
CSC854	Operations Research	3
Electives	**Choose any One**	
CSC856	Compiler Design and Construction	3
CSC822	Designing Complex Software Systems	3
CSC860	Computer Performance Evaluation	3
	Sub-Total	**6**

M.SC COMPUTER SCIENCE PROGRAMME

COURSE CONTENTS

CSC 711: Research Methodology and Application of ICT in Research 3 Units

In-depth research work aimed at acquiring full knowledge and presentations in scholarly writing of the concepts, issues, trends in definition and development of study area from African and Western perspectives. Major steps in research: Selection of problem, Literature review, Design, Data collection, analysis and Interpretation, Conclusions. Study of various research designs, Historical, Case studies, Surveys, descriptive, Cross sectional, Experimental, etc Analysis, surveys and synthesis of conceptual and philosophical foundations of different discipline. Identification of research problems, development of research questions and hypotheses; Detail treatment of methods of collecting relevant research data and the format for presentation of research results from designing the table of contents to referencing, bibliography and appendix); Data analysis and result presentation in different discipline using appropriate analytical tools. Methods of project/dissertation writing; Application of appropriate advanced ICT tools relevant in every discipline for data gathering, analysis and result presentation; Essentials of spreadsheet, Internet technology, and Internet search engines. All registered Masters Degree students must attend a solution based interactive workshop to be organised by the school of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

CSC801: Operating Systems (3 Credit Units)

Structural design aspects of an operating system: process model, inter-process communication, synchronization mechanism, resource management, and scheduling. Protection issues, Implementation issues of modern operating systems. Distributed operating systems. Deadlock detection, recovery, and avoidance. Case studies. Project(s).

CSC802: Computer Communications and Networks (3 Credit Units)

Channels and channel capacity; introduction to information theory; sharing network resources: telecommunication history; circuit switching and packet switching; multiplexing; FDM, TDM, statistical multiplexing; virtual circuits and datagrams; advantages and disadvantages; sharing the medium: Aloha, CSMA (persistent and non-persistent), CSMA-CD, token passing, and redundancy; hamming theory and codes; CRCs, ARQ protocols; CR

selective retransmission and flow control; internet working and internet: ISPs, datagram forwarding; the DNS; IPv4; addressing and forwarding; encapsulation and address resolution; TCP and UND; ports and congestion controls; example applications; modeling data networks: services and protocols; layered architectures; the OSI 7-layer model; introduction to queue theory; physical media; LANs and bridging; WANs and point-to-point links; routing; addressing and routing in the internet; end-to-end communication in the internet; and application protocols. Cyber space technology: Cyber Crime, Cyber Security and models of Cyber Solution; IPv6; 4GPP and LTE.

CSC803: Advanced Computer Architecture (3 Credit Units)

Design of advanced computers for parallel processing; emphasis on the overall structure; interconnection networks; including single-stage and multi-stage structures; shared memory and message passing architectures; control-flow and demand-driven programming; multithreaded architectures; fine-grain and coarse-grain parallelism; SIMD and MIMD; processor designs for parallel operation.

CSC804: Programming Languages (3 Credit Units)

Comparative study of the organization and implementation of a variety of programming languages and language features. Design principles are explored and applied in a history review of major languages. Procedural, functional, logic-based, object-oriented and languages. Research issues such as polymorphism, formal semantics and verification, exploration in depth.

CSC805: Software Engineering (3 Credit Units)

Software myths. Software engineering and its place as an engineering discipline. Life cycle of software system: Requirement analysis, development, operation and maintenance. Software metrics: Portability, Re-usability, Correctness, Reliability, Efficiency, Usability, Integrity, Maintainability and Flexibility. Product and process, software myth, development of test plans, test cases, testing techniques. Software quality and testing. Software architecture: architecture description languages, pattern-oriented software architecture, component-based development, distributed software architecture using middleware, enterprise application integration, architecture for mobile and pervasive systems and model driven architecture. Advanced modeling: UML extension mechanisms, object constraint language and model checking. Software project management: Study of interpersonal process decision making styles, problem solving concepts and procedures, creative effort, conflict resolution, leadership and assessment. Concepts of motivation, team work and group dynamics. Software engineering and law: intellectual property law, professional ethics and code of conduct. Overview of Open Source Software.

CSC806: Advanced Computer Algorithms (3 Credit Units)

Review of data structures; linear data structures, hashing, trees, graphs, recursion. Complexity classes; empirical measurements of performance; time and space tradeoffs analysis. Algorithmic strategies: Brute-force algorithms; divide-and-conquer; backtracking; branch-and-bound; minimum spanning tree, heuristics; pattern matching and string/text algorithms; numerical approximation algorithms. Tractable and intractable problems.

CSC807: Artificial Intelligence (3 Credit Units)

Introduction to basic programming techniques of artificial intelligence (AI). Domain analysis representation of knowledge and strategies, control on inference and search; development of interactive intelligence CAI programs, the role of analogical reasoning: the main contents are symbol manipulations and AI problem solving techniques. Topics include LIEP primitives LISP objects and evaluation, recursion and interaction and data abstractions (association list properties and DESTRUCT), macros, object centered programming, symbolic pattern matching and bane solving methods. Resolution and natural deduction, Knowledge engineering.

CSC 808: Switching Theory and Fault Diagnosing (3 Credit Units)

Switching Theory: Advanced topics applicable to the design of large scale digital systems. Asynchronous and speed independent circuits, static and dynamic hazards; use of race condition. Algorithmic State Machine design methods. Concepts of state assignment. Implementation with MSI, LSI and Programmable Logic. Design of Linked Machines. Register Transfer Language description of processor control algorithms. Reed-Mueller Algebraic descriptions. **Fault Diagnosing**: Fundamentals of testing theory and practice for complex VLSI designs. The objectives are to give the student the ability to solve a wide range of non-trivial testing problems using practical and cost effective techniques. Students will also learn to create test automation tools on their own. Topics covered include, Fault Modeling, Fault Simulation, Automatic Test Generation in Combinational and Sequential Circuits, Functional Testing of Microprocessors, ALUs and Memories, Design for Testability, Synthesis for Testability, Built-In Self-Test and Diagnosis.

CSC 809: Seminars (3 Credit Units)

Each student is expected to present at least **two seminars** to staff and colleagues on the progress made so far in the candidate's project.

CSC 810: Real Time Operating Systems (3 Credit Units)

Basic Real time concepts, Computer hardware, Language issues, Software life Cycle Real time specifications: Design techniques, Real-time kernels, Intertask communication and synchronization, Real –time memory Management Multiprocessing systems: Multiprocessing Systems - Hardware/Software integration- Real time Applications.

CSC 849: Thesis (6 Credit units)

With a high degree of originality expected of the student, each project is supposed to cover a review of current activity in the area of research, and be acquainted with latest publications in the candidate's field. Each student should also be free to work on any topic given to him by supervisor in any area of computer science. Students will also be required to demonstrate additional contribution he/she has made.

CSC812: Embedded Systems (3 Credit units)

Introduction: - What is an embedded system? Why is it special? What types of processor are used? What are the other peculiarities? **Processors for embedded systems: -** 8 bit processors 8085, 8051 and PIC 18FXX: - Architecture and instruction set. (already covered in microprocessor) 16 bit: - 8086 32 bit : - 80386 architecture and instruction set, ARM based processor architecture and instruction set. **Operating systems for embedded systems: - Real time operating systems Issues: - I/O programming:** Synchronization, transfer rate and latency. Polled I/O issues. Interrupt driven I/O. ISR. Response time interrupt controller. Software interrupts and exceptions. Buffering of data and queuing of interrupt requests. **Concurrency control**: Foreground/Background systems, Thread state and serialization, latency, prevention of interrupt overruns. Concurrent execution of threads, context switch, non-preemptive multitasking, preemptive multitasking. Critical sections:- disableing interrupts, disabling ask switch, spin lock, mutex and semaphore. **Scheduling in Embedded Systems:** Conventional scheduling, deadline driven scheduling, rate monotonic scheduling, deadlock, watchdog timer. **Memory Management:** Static allocation, dynamic allocation. Recursion and dynamic allocation. shared memory, reentrant functions. **Boot up and System initialization.** 80x86 microprocessor with a C compiler (suited for RTOS) and uC/OS RTOS may be used for practicals. Some real embedded application shall be taken up for practical.

CSC814: Software Project Management (3 Credit units)

Software management renaissance: Conventional Software Management, Evolution of Software Economics, Improving Software Economics; The Old Way and the New. A software management process framework: Live-Cycle Phases, Artifacts of the Process, Model-Based Software Architectures, Work Flows of the Process, Check Points of the Process . Software management disciplines; (I) Iterative Process Planning, Project Organizations and Responsibilities, Process Automation. Software management disciplines;
(II) Project Control and Process Instrumentation – Tailoring the Process Risk management: Introduction, Risk, Categories of risk, A framework for dealing with risk, Risk Identification, Risk assessment, Risk Planning, Risk Management, Evaluating risks to schedule, Applying the PERT Technique, Monte Carlo Simulation, Critical Chain Concepts

CSC815: Digital Signal Processing (3 Credit Units)

Introduction; brief review of analogue and digital signal processing systems, discrete time linear time-invariant signal processing systems; design of finite impulse response digital filters, introduction to z-transforms and infinite Impulse response type discrete time filters design of infinite impulse response type digital filters using analogue filter approximations;

digital processing of analogue signals and other data, introduction to the discrete Fourier transform.

CSC816: Database System (3 Credit Units)

A brief introduction to database concepts: File systems and database, and the relational database model; design concepts and implementation: entity relationship (E-R) modeling normalization of database tables and structured query language; database design and implementation. Transaction management and concurrency control and distributed database management systems, database: privacy, security, failure and recovery. Object-oriented database design, client/server systems, data warehouse, data mining, databases in electronic commerce, web database development and database administration

CSC817: Parallel and Distributed Computing (3 Credit units)

Introduction: Forms of Computing; Monolithic, Distributed, Parallel, Cooperative, Computational demands of parallel processing, Flynn's classification, Terminology. **Parallel computer architectures:** Classification, Interconnection networks, Vector computers, Shared memory parallel computers, Cache coherence, Distributed shared memory parallel computers, Message passing parallel computers, Cluster of workstations. **Parallel programming models:** Shared memory model, Message passing model - Synchronous and Asynchronous message passing models, Leader-Election algorithm, Breadth-First Search. Shortest Paths, Broadcast and Converge cast, Data Parallel model. **Parallel algorithms:** Models of parallel computation including PRAM - CRCW, CREW, ERCW, EREW models, Design and analysis of Parallel algorithms: Automatic vs. Manual Parallelization, Understand the Problem and the Program, Partitioning, Communications, Synchronization, Data Dependencies, Load Balancing, Granularity, I/O, Limits and Costs of Parallel Programming, Performance. Analysis and Tuning, Parallel Examples, Array Processing Matrix multiplication, Sorting, Searching, Merging, Minimum spanning tree, Prime numbers. **Distributed computing:** Introduction to Distributed Programming - *System Models*-Architectural models - Client-server model, Peer-to-peer model- Variations of the above models - Distributed computing paradigms, *Inter process communication* - The API for the Internet protocols, External data representation and marshalling, Group communication - Case study: inter process communication in UNIX, Distributed file systems. **Distributed programming algorithms:** Fundamental issues and concepts - Synchronization, Mutual Exclusion, Termination Detection, Clocks, Event ordering, Locking - Distributed Computing Tools & Technologies (CORBA, JavaRMI, Web Services). **Emerging areas of parallel and distributed systems:** Grid computing, Peer-to-peer systems, Overlay networks, Edge computing and Ad-hoc networks.

CSC818: Advanced Software Engineering (3 Credit units)

Formal methods: data invariant, constructive specification, formal methods guideline, formal specification, languages, logic operators, operations, pre- and post- conditions, sequences, set operators, Z-schemas, Z-notation. Cleanroom Software Engineering: black box specification, box structure, certification, cleanroom strategy, clear-box specification, design refinement, functional specification, proof of correctness, state-box specification, statistical use testing, stimulus, test probability distribution, verification. Component-Based Software Engineering: adaptation, CBSE activities, CBSE process, characterization functions, classification,

component-based development, component types, composition, domain engineering, ecomonics of reuse, qualification, structure points. Client/Server Software Engineering: analysis modelling, architectural design, architecture, components, configuration options, CORBA, database design, data distribution, function distribution, middleware, ORS, testing.

CSC819: Control Systems and Robotics (3 Credit units)

Introduction: Definitions and history of robotics, Sensors and actuators,Types of actuator, types of sensor, Robotic systems. Robot design, biologically inspired robotics, kinematics, dynamics, locomotion, control.Autonomous mobile robotic systems. Benefits, problems, suitable tasks, machine learning, navigation. Simulation, Simulation of a robot and its environment. Assessment of simulation accuracy. Model acquisition, and validation.

CSC820: Electronic Commerce Technologies (3 Credit Units)

Introduction: The Sociology and Psychology of Electronic Commerce, Building recognizing, managing and making use of online communities in web based environment, theories of online presence and cooperation, a guide to e-commerce in general; how to differentiate e-commerce today from e-commerce yesterday, current problems of e-commerce and interesting solutions and approaches to these problems, a guide to knowledge commerce, understanding knowledge and commodity and as a process, and representing it in web-based environment, web architecture: structural design of e-commerce systems, claimed server architecture, two-, three-tier design, server farms, scalability, integration of legacy systems, Java Beans, enterprise Java Beans, and Java server pages, particular problems posed by 24/7 operations and open user community; case-interchange; exchanging data over the internet. XLM, style sheet, document type definition, metadata and document discovery, interchange of processes using WSDL and SOAP; usability: user-interfaces designs for websites, use of human-computer interaction methodologies in evaluating user-interfaces; electronic payments; technologies that support the processing of electronic payments, characteristics and properties of electronic payment systems; mass personalization and the virtual customer's automation of the customer-relationship, use of data to customize the web experience, cookies and their risks, rule-based filtering, implicit profiling, collaborative filtering.

CSC821: Software Quality Assurance (3 Credit units)

Quality and the quality system, standards and procedures, Technical activities, components, Continuous Improvement, Software Tasks, Management responsibility, Quality System, Contract Review, Document Control, Product identification and trace ability.

CSC822: Design of Complex Software Systems (3 Credit Units)

Designing new computational systems and the software that drives them is both hard and interesting. One important aspect of computer science research, often called experiment systems research, revolves around such design activities. Research in this style seeks

advanced understanding of and our ability to create, general computer systems that support the development and use of more domain specific applications.

CSC823: Advanced Computer Graphics (3 Credit Units)

Prerequisites Knowledge of C programming language.

Reflection models: Texture and models, texture and environment mapping, advanced ray tracing, radiosity method, volume rendering, advanced modeling techniques, simulation and animation.

CSC827: Object Oriented Programming (3 Credit Units)

Procedural programming and its limitations. Software development methodology: Fundamental design concepts and principles; structured design; testing and debugging strategies; test case design; programming environments; testing and debugging tools. Basic concepts and formal methods of Object Oriented Programming (OOP). Study of the features of a popular Object Oriented Programming Language such as JAVA, Visual Basic and C++. Applications of OOP in systems software development.

CSC828: Introduction to Quantum Computing (3 Credit Units)

The theory of quantum information and quantum computation; classical information theory, compression of quantum information, transmission of quantum information through noisy channels, quantum enter element, quantum cryptography, classical complexity theory, quantum complexity; efficient quantum algorithms; quantum error-correcting codes, fault-tolerant quantum algorithms; quantum error-correcting codes, fault-tolerant quantum computation; and physical implementations of quantum computations.

CSC829: Internet Technology (3 Credit Units)

Introduction to Internet, standards and specifications; survey of contemporary internet technologies; Current Internet tools; Designing and publishing a web server; www programmed markup languages: Using alternative protocols in www, Adding multimedia features to www; Server side programming, client programming and database programming for the web; Security and Privacy.

CSC830: Human Computer Interaction (3 Credit Units)

Positive and negative effects of the computers and ICT on human beings and societies. Computing as a profession, organization using computers, sociological impacts of Computers individual and computers, computer as audit tool, computers in banking, computer based information systems and telecommunications, companies in consultancy servers, design and construction, education, government insurance, stock-brokerage, legal and medical professions.

CSC831: Object-Oriented Software Engineering (3 Credit units)

Structured approach to system construction: SSADM/SADT, An overview of object oriented systems development & Life cycle Various object oriented methodologies, Introduction to UML. Object oriented analysis, Use cases, Object classification, relationships, attributes. Object oriented design, Design axioms, Designing classes, Layering the software design:-data access layer, User interface layer, Control/business logic layer, UML, Examples on: Behavioral models, Structural models, Architectural models from real world problems. Object-Oriented Programming.

CSC832: Expert Systems (3 Credit Units)

Review of Artificial Intelligence and its place in experts system. Introduction to expert systems and expert support system. Characteristics of experts systems: knowledge-based systems. Types of expert systems.

CSC833: Design of Intelligent System (3 Credit Units)

Artificial Intelligence: An overview, Intelligent Systems: Evolution of the concept. **Intelligent Agents**: How agent should act, Structure of intelligent agents, Environments. **Problem Solving:** Solving problems by searching, Informed search methods, Game playing. **Knowledge and Reasoning:** A knowledge based agent, The wumpus world environment, Representation, Reasoning, Logic, Proportional logic, First order logic: Syntax and Semantics, Extensions and Notational variation, Using first order logic. **Building a Knowledge Base:** Properties of good and bad knowledge base, Knowledge engineering, General ontology. **Interfacing First Order Logic:** Interface rules involving quantifiers, An example proof, Forward and backward chaining, Completeness. **Acting Logically:** Planning, Practical planning: Practical planners, Hierarchical decomposition, Conditional planning. **Uncertain Knowledge and Reasoning:** Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief networks, Inference in belief networks. **Learning:** Learning from observations: General model of learning agents, Inductive learning, learning decision trees, Learning in neural and belief networks: Introduction to neural networks, Perceptrons, Multilayer feedforward network, Application of ANN, Reinforcement learning: Passive learning in a known environment, Generalization in reinforcement learning, Genetic algorithms **Agents that Communicate:** Communication as action, Types of communicating agents, A formal grammar for a subset of English **Expert system:** Introduction to expert system, Representing and using domain knowledge, Expert system shells, Explanation, Knowledge acquisition **Applications:** Natural language processing, Perception, Robotics

CSC834: Bio-Informatics (3 Credit Units)

Study of forensics; principles and practice of identification; pattern-matching of recognition, computer forensics: pattern recognition, data mining, machine learning algorithms and visualization, sequence alignment, application to biological sciences, DNA-gene finding, genome assembly, drug design, drug discovery, protein structure alignment, protein structure

prediction, prediction of gene expression and protein – protein interaction, genome-wide association studies and the modeling of evolution.

CSC835: Theory of Computation (3 Credit Units)

Formal languages, Chomsky hierarchy, formal computation and machine model, finite automata, pushdown automata, Turning machines, Church's Thesis, Recursively enumerable sets. Diagonal arguments. Reducibility, complexity classes.

CSC836: Machine Learning (3 Credit Units)

Overview and Introduction to Bayes Decision Theory: Machine intelligence and applications, pattern recognition concepts classification, regression, feature selection, supervised learning class conditional probability distributions, Examples of classifiers bayes optimal classifier and error, learning classification approaches. Linear machines: General and linear discriminants, decision regions, single layer neural network, linear separability, general gradient descent, perceptron learning algorithm, mean square criterion and widrow-Hoff learning algorithm; multi-Layer perceptrons: two-layers universal approximators, backpropagation learning, on-line, off-line error surface, important parameters. Learning decision trees: Inference model, general domains, symbolic decision trees, consistency, learning trees from training examples entropy, mutual information, ID3 algorithm criterion, C4.5 algorithm continuous test nodes, confidence, pruning, learning with incomplete data. Instance-based Learning: Nearest neighbor classification, k-nearest neighbor, nearest neighbor error probability. Machine learning concepts and limitations: Learning theory, formal model of the learnable, sample complexity, learning in zero-bayes and realizable case, VC-dimension, fundamental algorithm independent concepts, hypothesis class, target class, inductive bias, occam's razor, empirical risk, limitations of inference machines, approximation and estimation errors, Tradeoff. Machine learning assessment and Improvement: Statistical model selection, structural risk minimization, bootstrapping, bagging, boosting. Support Vector Machines: Margin of a classifier, dual perceptron algorithm, learning nonlinear hypotheses with perceptron kernel functions, implicit non-linear feature space, theory, zero-Bayes, realizable infinite hypothesis class, finite covering, margin-based bounds on risk, maximal margin classifier.

CSC838: Neural Networks (3 Credit Units)

Characteristics of Neural Networks, Historical development of Neural Network principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws. Activation and synaptic dynamics: Introduction, Activation Dynamic Models , Synaptic Dynamic Model, Learning Models, Learning Methods. Functional units of ANN for pattern recognition tasks: Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units, Feed forward neural networks: introduction, Analysis of Pattern Association Networks, Analysis of Pattern classification Networks, Analysis of Pattern Mapping Networks. Feedback neural networks: Introduction, Analysis of Linear Auto Associative FF Networks, Analysis of Pattern Storage Networks. Competitive learning neural networks: Introduction, Components of a Competitive Learning Network, Analysis of Feedback Layer for Different Output Functions, Analysis of Pattern Clustering Networks, Analysis of Feed Mapping Network. Applications of neural systems: Applications

of Neural Algorithms and Systems character Recognition, Expert Systems Applications, Neural Network Control Applications, Spatio - Temporal Pattern Recognition and other Applications.

CSC840: Decision Support Systems (3 Credit Units)

Overview of different types of decision making: strategic, tactical and operational. Considerationof organisational structures. Mapping of databases, MIS, EIS, KBS, expert systems, OR modelling systems and simulation, decision analytic systems onto activities within an organisation. Extension to other 'non organisational' areas of decision making, e.g. military and emergency management. Studies of human cognition in relation to decision making and the assimilation of information. Cultural issues. Implications for design of decision making support. Communication issues. Normative, descriptive and prescriptive analysis: requisite modelling. Contrast with recognition primed decision tools. Database, MIS, EIS, KBS, Belief nets, data mining. OR modelling tools: simulation and optimisation. History, design, implementation: benefits and pitfalls. Risk assessment. Decision analysis and strategic decision support. Group decision support systems and decision conferencing. Intelligent decision support systems: tools and applications. Cutting-edge decision support technologies. History, design, implementation: benefits and pitfalls. Quality assurance and validity of decision support. RODOS: A decision support system for nuclear emergencies. In depth study of a system in which almost all of the techniques come together into one system. Discussion of design. Implementation issues.

CSC842: Network Administration and Management (3 Credit Units)

The rules governing IP address classes and netmasks, Configuring the resolver library to arrange for TCP/IP name service, Bringing interfaces up and down, and set their IP addresses and netmasks, Setting the default route in the kernel routing table. Understanding the significance of the /etc/services file and well-known port numbers, Configuring the inet daemon, Using telnet to contact servers directly, using the ping command to test network connectivity, netstat command to examine kernel tables pertaining to networking, trace-route command to discover network paths, tcpdump to examine all network traffic. Methods used to bring interfaces up and down. Basics of configuring and using the Domain Name Service, sendmail, the Network Information System, Network File System: Structure and function of the Domain Name Service (DNS), Setting up a Linux machine to function as a DNS server, Configuring and using sendmail, Setting up an NIS domain with an NIS master server and NIS clients.

CSC843: Agent Technology (3 Credit Units)

Introduction to software agents: definition, attributes, different classes of software agents, uses of agents. **Agents and the user experience:** user‟s interaction with agents, agents from direct manipulation to delegation, interface agents, designing agents, direct manipulation versus agents. **Agents for learning and intelligent assistance:** agents for information sharing and coordination, agents that reduce work and information overload, agents for cooperative learning, the M System. **Agent communication, collaboration and mobility:** agent oriented programming, Agent Communication Languages, agent based frameworks, communicative actions for artificial agents, Mobile agents. **Multiagent systems:** objectives and objections, multiagent interactions, communication, Agent security issues, Black Box

Security. **The FIPA model for software agents:** Agent Lifecycle Management, Message Transport, Message Structure, Inter-agent Interaction Protocols, Ontologies, Security. **Agent Programming:** overview of Java based programming environments- ABLE, AgentBuilder, Aglets, FIPA-OS, Gossip, JADE, JATLite, Jess, Voyager, ZEUS etc; Other non-java environments; Programming static and mobile agents in any one such environment.

CSC844: Advanced Topics in Computer Network (3 Credit Units)

Data Communications: Business Drivers and Networking Directions : Data communication Past and future. **Understanding the standards and their maker:** Creating standards: players and Process, Current forums, Standard protocols, Layered reference models: The OSIRM, Standard computer architectures. **Introduction to Transmission Technologies:** Hardware selection in the design process. **Optical Networking:** SONET/SDH standards, Dense wavelength division multiplexing (DWDM), Performance and Design considerations. **Physical Layer Protocols and Access Technologies:** Physical Layer
Protocols and Interfaces, Accessing the Network, Copper access technologies, Cable Access Technologies, Fiber Access Technologies, Air Access Technologies. **Common Protocols and Interfaces in the LAN environment:** Data link layers protocols, LLC and MAC sub layer protocol, Ethernet, Token Ring, Token Bus and FDDI, Bridge protocols, Switching in the LAN environment. **Frame Relay:** FR specification and design, VoFR: Performance and Design considerations, Advantages and disadvantages of FR. **Common WAN Protocol:** ATM: Many faces of ATM, ATM protocol operation (ATM cell and Transmission), ATM networking basics, Theory of operations, BISDN protocol reference model, PHY layer, ATM layer (Protocol model), ATM layer and cell (Definition), Traffic descriptors and parameters, Traffic and Congestion control defined, AAL Protocol model, Traffic contract and QoS, User plane overview, Control plane AAL, Management plane, Sub-DS3 ATM, ATM public services. **Common Protocols and Interfaces in the Upper Layers(TCP/IP):** Background (Routing protocols), TCP/IP suite, Network layer (Internetwork layer), Transport layer, Application layer, Addressing and routing design. **Mature Packet Switched Protocol:** ITU Recommendation X.25, User connectivity, Theory of Operation, Network layer functions, X.75 Internetworking protocol, switched multimegabit data service (SMDS), SMDS and IEEE 802.6, Subscriber Interface and Access protocol, Addressing and Traffic control. **Requirements Definition:** User requirements, Traffic sizing, Traffic characteristics, Protocols, Time and Delay considerations, Connectivity, Availability, Reliability and Maintainability, Service aspects, Budget constraints.

CSC845: Network Design (3 Credit Units)

Requirements, planning, and choosing technology: System requirements, traffic sizing characteristics time and delay consideration. **Traffic Engineering and Capacity planning:** Background (Throughput calculations), Traffic engineering basics (Traffic characteristics), Traditional Traffic engineering, Queued data and packet switched traffic modeling, Designing for peaks, Delay or Latency, Availability and reliability, Capacity planning and Network vision, Design tool, Categories of tools, Classes of design tool, Components of design projects, Types of design projects. **Technology Comparisons:** Circuits-message-packet and cell switching methods, Packet switching service aspects, Generic packet switching network characteristics, Private verses public networking, Public network service selection, Business aspects of Packet-Frame and cell switching services, High speed LAN protocols comparisons, Application performance needs. **Access Network Design:** Network

design layers, Access layer design, Access network capacity, network topology and hardware, completing the access network design. **Backbone Network Design:** Backbone requirements, Network capacities, Topologies, Topologies strategies, Tuning the network.

CSC846: Network Programming (3 Credit Units)

Sockets and Socket Address structures, Concept of Zombies, Daemon Processes, Super servers, Concurrent versus Iterative servers, Protocol Independence, Error Handling: Wrapper functions, OSI Model, Unix standards. TCP Connection establishment and Termination, Port Numbers and Concurrent Servers, Protocol Usage by common Internet Applications. UDP Communication Semantics, UDP Echo Server, Echo Client working, Protocol Usage by Common Internet Applications. Sockets Address Structures, Byte ordering & M anipulation Functions, TCP Socket System Calls, TCP Client-Server E.g., I/O Multiplexing, Signal Handling in Concurrent Servers. Socket Options, Elementary Names Address Conversions, Ipv4 and Ipv6 Interoperability.

CSC847: Mobile and Adaptive Systems (3 Credit Units)

Introduction and overview; properties of wireless: PANs and WANs: Ad-hoc and infrastructure networks; physical constraints and limitations (transmission and reception), network structures and architectures, including hand-off and mobility support at the physical/link level; example technologies at the physical/link layers; PANS Bluetooth, LANs IEEE802.11 HiperLAN, basic GSM and GPRS network structures and protocol architectures, next generation wireless overview including UMTs, IMT-2000 and W-CSMA; mobile IP; mobilePv4 and mobileIPv6, problems. With routine, quantity of service and security, overview of use of intelligence in mobile systems and power management issues; file systems: CODA and the like and mobile infrastructures support. Adaptive and re-configurable systems, mobile multimedia and its relationship to proxying, context sensitive applications, ubiquitous computing, pervasive computing and ambient networking, overlay networks and vertical hand-offs, programmable networking and applications for mobile systems, code mobility and control/signaling.

CSC848: Network Performance Evaluation (3 Credit Units)

Network performance modeling- Creating traffic matrix, design tools, components of design tools, types of design projects. Technology Comparisons- Generic packet switching networks characteristics, private vs.public networking, Business aspects of packet, frame and cell switching services, High speed LAN protocols comparison, Application performance needs, Throughput, burstiness, response time and delay tolerance, selecting service provider, vendor, service levels etc. Access Network Design- N/W design layers, Access N/W design, access n/w capacity, Backbone n/w design, Backbone segments, backbone capacity, topologies, Tuning the network, securing the network, Design for network security. Documentation and network management- Documentation, network management, SNMP, RMON Network Optimization- Network optimization theory: Goals of network optimization, Measurements for network optimization, optimization tools, optimization techniques.

CSC852: Network Security (3 Credit Units)

Overview-Symmetric Ciphers: Classical Encryption Techniques Symmetric Ciphers: Block ciphers and the Data Encryption Standards, Public key Encryption and Hash Functions: Public-Key Cryptography and RSA Network Security Practices: Authentication applications-Electronic Mail Security, Network Security Practices: IP Security-Web Security System Security: Intruders-Malicious Software-Firewalls

CSC854: Operations Research (3 Credit Units)

Introduction to Operations research. Treatment of some of these topics and the applications of computer in their solution: Decision Theory, Game Theory, Inventory Control, Linear Programming Problems (Simplex Method of Solution), Transportation Problems, Assignment problems, Project/Network Analysis, Forecasting, Queuing Theory, Simulation.

CSC 856: Compiler Design and Construction (3 Credit Units)

Anatomy of a compiler, lexical analysis (scanning): syntax analysis (parsing): syntax-directed translation; semantic analysis, intermediate code generation; code generation and optimization. Advanced topics include garbage collection; dynamic data structures, points analysis, aliasing; code scheduling, pipelining; dependence testing; loop level optimization superscalar optimization; profile-driven optimization, debugging support; incremental parsing; type inference; advanced parsing algorithms; practical attribute evaluation; functional in-lining and partial evaluation.